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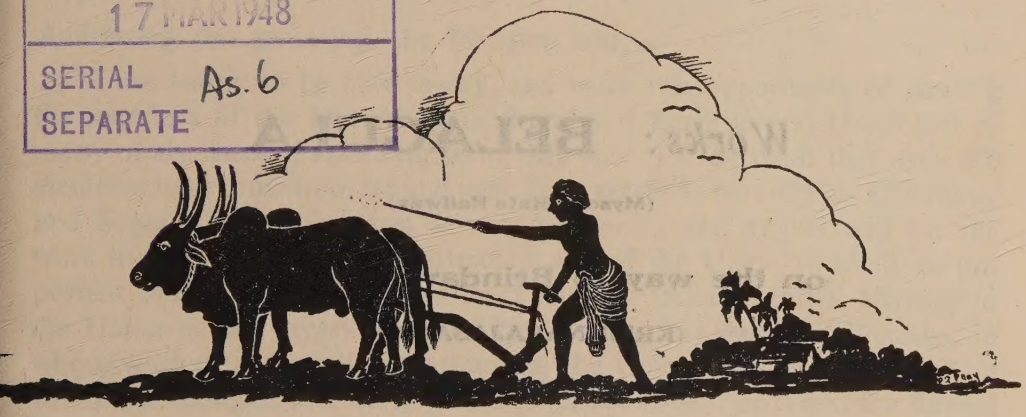

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The

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The Mysore Agricultural Journal

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FIELD DAY ADDRESS

Mr. M. A. Sreenivasan, B.A., Minister for Agriculture, presided on the occasion of the "Field Day Assembly" of the Mysore Agricultural and Experimental Union at the Irwin Canal Farm on the 25th November 1945.

Addressing the gathering, the Minister said:—

I am happy to be here to-day, and value this opportunity of meeting the members of the Mysore Agricultural and Experimental Union and so many of the leading agriculturists of Mysore. I understand that over 200 members have come from far and near, from places as far away as Chitaldrug and Sagar. This enthusiasm is very heartening and augurs well for the work of the Agricultural Department, and of the Union which is an important link between the Department and the farmer. In his Message to the Union on the occasion of its Silver Jubilee, last year, Dr. Coleman, to whose wisdom and practical enthusiasm the Union owes its origin, and to whom our thoughts and warm greetings go out to-day, described the Annual Field Days of the Union as among the most enjoyable and stimulating of his experiences in Mysore. It was with no little eagerness, therefore, that I looked forward to the pleasure of attending the Field Day Assembly this afternoon.

Importance of Agriculture

I regard it as a piece of good fortune to be directly associated with the subject of agriculture—a subject of whose vital and paramount importance to our country and our people, I need not tell an audience like the one before me—an industry that has been practised since the dawn of history, and seems yet to be in such an elementary stage particularly as compared with most other countries, and therefore, to hold infinite possibilities of growth and progress. I can make no claim to be a farmer, nor to be a technical expert; but perhaps my very newness to the subject makes it so fascinating to me, and I am eager to learn from the highly qualified and experienced Officers of the Department, retired or active, as well as from progressive practical agriculturists of the kind that are gathered here.

You will all agree that we have had an interesting session, and the talks we have just listened to have been instructive and stimulating. I am glad

that the " Grow More Food " scheme found a prominent place in the agenda. The deficiency of rainfall in several areas of the State has given cause for some anxiety in regard to food production and prospects; and there is no subject which calls more urgently for our attention than the by no means easy question of how to make the Grow-More-Food effort more really effective and fruitful of result than it has been.

Apart from the comparatively long-range plans of extended irrigation, intensive manuring, improved seed, and mechanisation, there is an idea which strikes me as one that could be of immediate benefit as well as of considerable potential value. We have on the margin of the Krishnaraja-sagara lake a total area of something like 5,000 acres which is under water for about five months in the year, and gradually gets unsubmerged and becomes available for cultivation,—five thousand acres of good earth, annually offered by the goddess of the River Cauvery, saturated with water and perennially enriched by deposits of silt. It seems to me that, by an energetic and co-ordinated effort, it should be possible to raise on a good portion of this land many hundreds of tons of valuable food and cattle fodder, like jola, and vegetables which are so sorely needed. It should not, indeed, be difficult to make the annual cultivation of these lands a permanent feature, by the construction of a series of bunds and sluices to regulate and define the annual ebb and flow of water. Some of you may have heard of how in Travancore, paddy was raised on what was once the bed of a vast backwater lake, by pumping water from one portion of the lake to another, across an earthen bund ingeniously raised right in the middle of the lake, a process of irrigation in reverse gear. If this has been successfully done in Travancore, one can see no reason why the cultivation of our Krishnarajasagara and other lake margins, which presents fewer problems, should not be practicable; and I would ask for your suggestions and co-operation in making this scheme a success.

Dr. Narayanan has referred to the very great manurial value of *humus* and to the importance of the manufacture of compost out of farmyard and habitation waste, and to the notable progress that has been made in this direction in certain mofussil towns and rural areas of the State. I was glad to find a more lively appreciation of the value of compost in the Mandya and Irwin Canal areas than in most other parts of the State, and hope that every town and village in this area will adopt this process of making wealth out of waste.

Agricultural Courses

Mention was made of the need of an Agricultural College. I may at once say that this question has already been taken up by Government and that unless unforeseen difficulties arise we may well hope to see inaugurated, with the next academical year, a Faculty of Agriculture in the University and a College of Agriculture and Veterinary Sciences at Hebbal near Bangalore.

Sugarcane Research

The problems of sugarcane cultivation are, I know, of particular interest o Mandya District and the Irwin Canal area, not the least serious among hem has been the disquieting diminution in the yield per acre, in spite of he use of improved seed. It is believed that the falling yields are caused, mong other things, by water-logging and the rapid rise of the water-table n the area. All these matters call for investigation and study, and I think will interest this assembly to learn that soon it is hoped to establish a ugarcane Research Station at Mandya with the aid and under the auspices f the Imperial Council of Agricultural Research.

It now remains for me to congratulate the Union on another year of uccessful work, and to thank them for inviting me to preside over this ssembly. Mr S. Srinivas, who has been the Vice-President of the Union uring the past years, is shortly leaving that office and I am sure you would ke me on this occasion to express our appreciation of the ability and enthu- iasm with which he carried out his duties.

Some Observations Made on the Biology, Habits and Control of the Paddy Stem-Borer (*Schoenobius incertellus* Wlk.)

By M. Puttarudriah, B Sc. (Hons.)
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Introduction

The paddy stem-borer is the caterpillar of the moth *Schœnobius incertellus* Wlk., of the sub-family Schœnobiinæ under the family Pyralidæ. This insect is a common and often serious pest of paddy. its incidence becoming greater in areas where two crops are taken in succession. Damage is done both to the seedlings and mature plants, producing "Dead-hearts" in the former and white empty earheads in the latter. Two generations are generally gone through in each cropping season.

Biology. Life-history

Egg.—The female moth lays eggs on the blades in clusters covered with yellowish hairs derived from the tip of its abdomen. The number of egg-masses per individual and the number of eggs in each of the clusters vary. A large number of egg-masses were examined for the number of eggs which were found to range from 5 to 80, the average per egg-mass being 25. Below the hairy covering, the eggs appear oval, flat, scale-like and overlap one another.

Larva.—The egg hatched in 9–10 days during the monsoon months. The first instar larvæ measured 1·5 mm. long and 0·5 mm. broad. The body colour was pale white, head and prothoracic shield being dark brown and prominent. Ventrally was a ringlike white space between the thoracic shield and abdomen. The first moult took place after 5–6 days from the date of hatching. The second instar larvæ after the 8th day from hatching measured 3·0 mm. long and 0·5 mm. broad; was pale dirty white in colour mottled dorsally and whitish ventrally, the head and prothoracic shield being clear and light brown.

The second moult occurred after 4–6 days from the first moult. The third instar larvæ after fifteen days from hatching measured 3·5 to 4·0 mm. long and 0·75 mm. broad looking dirty whitish in colour with a space between each of the segments marked out by a light dark ring.

After the third moult which took place 5–7 days after the second moult the fourth instar larvæ measured 5·0 mm. long and about 1·0 mm. thick. They were dirty yellow in colour.

The fourth moult was observed after 10–12 days from the third moult and the fifth instar larvæ measured 8·0 to 9·0 mm. long and 1·5 to 2·0 mm. broad being yellowish white in general body colour, having a brown or orange yellow head.

The fifth moult occurred 9–10 days after the fourth. The sixth instar larvæ measured 12 mm. long and 2·0 mm. broad colour remaining the same as in the previous instar.

Some full-grown larvæ in the field collections were found to measure up to 20·0 mm. long and 2·5 mm. broad colour being yellowish white and head orange yellow.

Mode of pupation.

The sixth instar larvæ soon after the pre-pupal moult was found to make a thin silken case over itself in the stem for pupating. Before pupating an exit hole was cut. When insufficient lengths of paddy stems were provided, the larva was found to make more than one exit hole, abandon them and thus adjust itself, till finally, an exit hole was made above the node and the circular opening was covered with a thin webbing. Thus adjusting the exit hole to the suitable place, it pupated in the larval burrow in a day or two, with a silken covering. In the seedlings in the field, the larvæ were found to pupate near the root region only. The larval period thus extended from 4 to 5 weeks.

Pupa.—Pupæ were found to measure 12·0 mm. long and 3·0 mm. broad, being pale coloured at first, gradually turning dark brown, in the thoracic and cephalic area ventrally. The abdominal region including a few segments remained pale. The duration of the pupal stage was 10–12 days.

Moth.—The adult moth emerged through the exit hole previously made by the full-grown larva in the stem, the life-cycle from egg to adult stage occupying 1½ to 2 months—egg 9–10 days; larva 30–40 days and pupa

TABLE I

Life-history of Schœnobius incertellus *Wlk., showing the dates of different moults and instars*

Sl. No. of the larvæ	Dates of						Pupation	Emergence of moth
	Hatching and I instar	I Moult and II instar	II Moult and III instar	III Moult and IV instar	IV Moult and V instar	V Moult and VI instar		
1	13-11-40	18-11-40	23-11-40	30-11-40	10-12-40	20-12-40	22-12-40	31-12-40
2	13-11-40	17-11-40	21-11-40	25-11-40	7-12-40	17-12-40	Larva dead	
3	13-11-40	17-11-40	20-11-40	26-11-40	8-12-40	17-12-40	20-12-40	31-12-40
4	13-11-40	17-11-40	2[illegible]-11-40	2[illegible]-11-40	7-12-40	18-12-40	20-12-40	30-12-40
5	13-11-40	17-11-40	20-11-40	24-11-40	5-12-40	15-12-40	17-12-40	29-12-40
6	13-11-40	17-11-40	21-11-40	25-11-40	Larva dead			
7	13-11-40	17-11-40	21-11-40	Larva	not traced			
8	13-11-40	17-11-40	20-11-40	26-11-40	7-12-40	16-12-40	18-12-40	27-12-40
9	13-11-40	17-11-40	22-11-40	27-11-40	11-12-40	20-12-40	21-12-40	31-12-40
10	13-11-40	18-11-40	20-11-40	27-11-40	10-12-40	20-12-40	22-12-40	31-12-40
11	13-11-40	17-11-40	20-11-40	26-11-40	8-12-40	17-12-40	Larva dead	
12	14-11-40	18-11-40	21-11-40	26-11-40	8-12-40	17-12-40	18-12-40	30-12-40
		5–6 days	4–6 days	5–7 days	10–12 days	9–10 days	1–2 days	Pupal period, 10–12 days

10–12 days. The female moth is bigger in size than the male, with fore-wings bright yellowish brown with a clear black spot in the centre. Wing venation is prominent. Antennæ are filamentous and unsegmented. The maxillary palpi are well developed, erect and longer than those in the male. Proboscis is vestigial. The abdomen is wide, the tip being covered with tufts of yellowish hairs in a circlet around a ventral opening. The male moth is smaller in size with a slender abdomen, the anal end with a thin hairy covering dorsally. The colour is pale yellow, the spots on the fore-wing are not conspicuous. The maxillary palpi are short and not well developed.

Incidence.—During 1940 the incidence of this pest in 9 varieties of paddy was studied in a subvention farm at Hampapur in Krishnarajanagar Taluk. Extent of area selected, age of the crop and cultivation practices, etc., were the same for all the varieties studied. The crop was in the stage of earhead formation. Clumps varying in number for each variety were selected at random in all the plots, and number of healthy and infested tillers were counted. The percentage of infestation was struck on the consolidated figures of tillers. As can be made out from Table II, the infestation irrespective of the variety was 5·0%. S. 661 and S. 699 being heavily infested.

TABLE II

Paddy stem-borer incidence (examined on 18–11–1940)

Variety of paddy	No. of cl mps examined	Total No. of tillers	Total No. of healthy tillers	Total No. of infested tillers	Average No. of tillers per clump	Percentage of borer infestation
S. 199 ..	25	370	364	6	15	1·6
S. 699 ..	40	552	508	44	14	8·0
S. 624 ..	20	396	394	2	20	0·5
S. 139 ..	20	316	313	3	15	1·0
S. 246 ..	20	299	286	13	15	4·3
S. 661 ..	40	597	523	74	15	12·3
S. 67 ..	10	143	142	1	14	0·6
S. 476 ..	10	138	138	..	14	..
G. E. B. mixed Ryots areas	20	290	274	16	14	5·5
Total ..	205	3,101	2,942	159	Average 15	Average 5·1

Infestation was also studied in the stubbles in harvested fields of both summer and monsoon crops. During August 1940 at Hebbal Farm, 39 clumps of stubbles, 12 days after harvest of summer crop, were collected at random in ten plots. There was a total of 585 tillers the average number of tillers per clump being 15. Only 12 tillers showed signs of infestation. Pupal cases were seen at the root region of 2 tillers, pupæ in 4, and frass material in 6. The percentage of infestation was found to be 2·0.

Again during February 1941, 80 clumps of stubbles from recently harvested monsoon paddy at Hebbal Farm, were pulled out at random in the wet area. The total number of tillers was 1018, average per clump being

13. The infested tillers were 81, of which nearly half the number showed *Sesamia-inferens* larvæ common in jola and sugarcane. The others had larvæ of *Schœnobius incertellus*, pupæ and frass material. The total infestation (irrespective of the kind of borer) was 8·0% of which 4·0% had to be ascribed to the Schœnobius.

Habits

(i) *Habits of the larva.*—The habits of the larvæ, both young and old, were studied by introducing them on the seedlings grown in pots with suitable enclosures. Observations were also made when the caterpillars hatched from the egg-masses laid on the blades. Just hatched first instar caterpillars move downwards and wander all over the stems and blades for one or two hours. Some drop on water, or when put on water they swim freely in search of seedlings and get up the plants. In the absence of seedlings tender larvæ do not survive for long in water. Some hang down by spinning threads and get blown off to neighbouring plants. They get into the leaf-sheaths wherever the space is open enough between the stem and the leaf-sheaths, even at the top of the seedlings and feed upon the green tissue of the stem or the sheath for 2-3 days. Then they bore into the stem or the sheath if the latter is thick enough. This was observed to occur in any portion of the plants even at the top. When dropped on water they crawled upto the plants and some were found to bore into the leaf-sheath at the base, from outside. Clear circular holes could be made out on the sheaths on the stem. The larvæ were observed to bore in at different periods of the first instar stage, on the second or fourth day or still later, depending upon when they get at the tender portions of the seedlings. Several pin-holes were sometimes observed on the same stem, but on splitting open only one larva could be seen inside. The caterpillar bores in at several places before finally getting in. More than one caterpillar were also seen boring but many come out and get on to other plants. The young larvæ were observed to bore in at the base producing the "Dead Heart" or at the top of the shoot and into tender grains in older plants producing white empty earheads.

When the central shoots dry up, the caterpillars come out and crawl on to other seedlings. Younger larvæ hang down and are blown to neighbouring plants. Older larvæ make cases from the tips of the blades to act as floats and wriggle on water like case worms of paddy with leaf cases.

Case making.—No first instar larvæ were observed to make cases. Older larvæ from second instar onwards were found to make cases, when they came out of dead plants or when introduced on to seedlings. The caterpillar first feels the surface of the blade, then makes threads from one margin to the other, thus making a cover over itself. The margins gradually close up and join as the threads harden and contract. Then the blade is cut from one margin to the other across the mid-rib or from each margin to the

the mid-rib which is finally cut. The case is cut at the tip first and then the base and falls down with the larva on water. Instances were observed when the case was cut at the base first, in which case it hangs down by the continuity of threads over the other portions of the blade. The time taken for cutting the case was on the average 50 minutes and in all the instances observed the case was found to be completed and fallen down during the nights. The larva wriggles on water with the case, putting out three-fourths of the body, to reach the base of a seedling. Then it bores into the stem just above the water level or crawls up the stem to a little height and bores in, finally getting into the stem, leaving the case behind which can be seen sticking at the entrance, at right angles to the stem. The average time for boring in was found to be an hour and a half. The larva bores down the main stem and when split open, is seen at the root region, even below the soil level. The "dead heart" or the white empty earhead begins to show on the fourth day after boring. The tip of the central shoot fades and dries up in a day or two Instances of making cases in thick midribs by the larva tunnelling and cutting it were also observed. Case making was not universal also as some younger larvæ were found to bore in without making cases first. When the first attacked plants dry up, the caterpillars come out and make cases for reaching the other plants.

(ii) *Habits of the adult.*—Moths are inactive during the day and can be seen easily, sitting on the stems and blades of paddy. They are active after dusk and are strongly attracted to bright light. They are short lived and die in 2–3 days after laying eggs.

Control

Light trap.—As the moths are strongly attracted to bright light, some experiments were carried out during 1940 to get an exact idea of the utility of a light trap. During March-April 1940, Petromax light traps were set up in two blocks G B. II and Shivalli A.B.C. and Nurseries at the Irwin Canal Farm. They were continued for 10 days and the number of moths collected over the water pans under the two light traps were as in Table III, 551 and 1353 respectively.

The moths collected at the Irwin Canal Farm were examined for gravid females. Six lots of varying number of moths were teased for their abdominal contents and 40% of partly gravid females were counted.

During November 1940, at Hebbal Farm, petromax light trap was set up for 2 days and 50 moths were attracted, of which 15 were partly gravid females. Again during February 1941, petromax light trap was set up at Hebbal Farm near the just transplanted areas for three days and 96 moths were collected of which 42 were females. During November 1940, a large number of paddy borer-moths were seen attracted to the electric lights in the town of Krishnarajanagar, the paddy fields being situated more than a mile from the town. As light traps help in reducing the population of the

The Paddy Stem-Borer (*Schoenobius incertellus Wlk.*)

Fig. 1. Eggmass with hairy covering. Fig. 2. Eggmass without hairy covering. Fig. 3. Full grown larva. Fig. 4. Pupa. Fig. 5. Female moth. Fig. 6. Tender larvæ hanging by spinning threads. Fig. 7. A larva with a case wriggling on water. Fig. 8. A case sticking on the stem at the boring point. Fig. 9. A "dead heart". Fig. 10. White and empty earhead.

TABLE III

Moths attracted to light traps at Irwin Canal Farm

Date	No. of moths in G. B. II	No. of moths in Shivalli A,B,C. and Nurseries
27-3-40	72	97
30-3-40	68	93
31-3-40	96	82
1-4-40	63	90
2-4-40	34	85
3-4-40	20	74
4-4-40	18	300
5-4-40	98	260
6-4-40	52	254
7-4-40	30	18
Total ..	551	1,353

moths at the time of egg-laying bright petromax lights set up during dark nights once at the nursery and transplanting stages each and again just before earhead formation and continued each time for a week may be considered to be of appreciable value..

I am grateful to Mr. B. Krishnamurti, Entomologist, for his kind instructions and guidance in preparing this paper. My thanks are also due to Mr. Raghuram, Artist, for his help in preparing the diagrams.

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Crop Mixtures in Mysore

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Part I

Throughout the Orient and in the Tropics, it is very common to find several crops growing simultaneously side by side on the same piece of land. On first sight, this bewildering medley of crops, baffles one accustomed to single crop farming or stands of pure crops. Perplexed at the apparent haphazard manner in which unrelated crops of diverse habits are raised together, the system of farming is often condemned *slovenly* or *unthrifty*.

A more exhaustive study of the problem has inevitably resulted in an entire reversal of the earlier unfavourable verdicts. An unqualified appreciation of the *utility* of these crop mixtures of which F. H. King deals exhaustively, is to be found in "Farmers of Forty Centuries". Indian practices are dealt with by Wallace, J. A. Voelcker and J. Mollison*, and repeated references to it are to be found in the writings of numerous other students of agriculture in India. One of the earliest accounts of this type of farming in Mysore is given by Francis Buchanan in "A Journey from Madras through the Countries of Mysore, Canara and Malabar". The bulletin on Cultivation of Ragi in Mysore by Leslie C. Coleman and the "Field Crops of India" by A. K. Yegna Narayana Aiyer, abound in references to this mode of raising crops.

These crop mixtures invariably include one or more legumes. The effect of these on their associates, has formed a field of very interesting and fruitful investigation. The work of J. G. Lipman in the United States of America, A. I. Virtanen and his associates in Finland and H. G. Thornton and H. Nicol at Rothamstead, England, have evoked considerable interest. In India, the investigations of Albert Howard at Pusa, G. F. Keatings and H. H. Mann in Bombay, J. W. Leather in Punjab, R. L. Sethi in the United Provinces and B. Viswanath and G. N. Rangaswami Ayyangar in Madras, have shed considerable light on the role of these legumes in sustaining the productivity of the soil and enhancing the yield of the non-legume associates included in the mixture. The claim is often advanced that, the legumes also improve the quality of the produce obtained from other crops raised along with them.

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* Wallace, "India in 1887". J. A. Voelcker, "Report on the Improvement of Indian Agriculture". J. A. Mollison, "Text-book of Indian Agriculture".

At present, it is a matter of conjecture as to the causes which gave rise o this type of farming. In the tropics, the beginnings of agriculture ought to have been arduous, as the land for crops had to be wrested from the forest or grass and kept free of further encroachment. The toil was all manual, implements being non-existent or crude and animal labour probably scarce. Even to-day, the rigour of the climate and the prevalence of cattle diseases, precludes the use of draft animals for crop husbandry in many tropical countries. Under these conditions, the cultivated area was of small extent, and as the initial fertility began to diminish the land was abandoned and fresh patches cleared again. Favourable conditions for plant growth, enabled the cultivator to raise a series of crops in quick succession. Pressed for time and space, he soon learnt the art of interpolating one crop in another and made the utmost out of the land.

As settled agriculture began to develop in favourable localities, the pressure of people living either directly or indirectly on the land began to increase and soon became oppressive. In the East, the land has always directly supported a large portion of the populace. As mixed farming developed, the number of livestock to be maintained also (consequentially) increased; probably much in excess of the actual need. The continuation of these trends through the ages has resulted in India maintaining at present not only one of the most dense populations in the world, but also the largest c ncentration of livestock to be found anywhere. The resulting pressure on land, perforce made it imperative for agriculture to spread to uncongenial situations and climes. The poverty of the land and the seasonal nature of the rainfall, necessitated the formulation of a system of dry farming. the returns from which though meagre and fluctuating atleast assured a minimum of existence, and could hardly be improved upon in the prevailing circumstances.

Lacking facilities of communication and cheap transport, agriculture developed strong tendencies of self-sufficiency and social independence. These traits were strengthened by the mode of life in vogue, which reckoned the village in its entirety; not only as a unit for purposes administrative, but also in matters economic, civic and social. Holdings became small and scattered, the return from land being ever uncertain and always at the mercy of the monsoon. The few interspersed areas that command facilities of irrigation, have always exercised a stabilising influence amidst this welter of precarious and uncertain living.

Faced with these features, a large proportion of the arable area had always to be devoted to the production of food and feed, most crops fulfilling both purposes. This dual nature of crops has precluded the possibility of evolving types that may prove efficient either for one purpose or the other. Soil and climate have further moulded this crop-husbandry into a pattern, in which crops have become highly and efficiently adapted. The area devoted

to crops other than food and feed, has always remained small. In regions where agriculture is solely dependent on natural precipitation, the maximum return available had always to be sacrificed in favour of a lower but more reasonably certain output. Since rotation with its attendant benefits could not be advantageously incorporated into this type of farming, plant industry developed along lines known variously as *mixed, multiple,* and *companionate,* cropping.

These crop mixtures are more in evidence under conditions of dry farming than under irrigation. The largest area of irrigable land is usually devoted to paddy which, as a rule, is grown pure. Perennial crops like tea and rubber, especially under European management offer other instances of mono-culture.

The needs of the cultivator primarily determine the nature of these mixtures and their individual make-up. These are combined in such a manner as to make the utmost use of available resources for plant growth. Since the available manure is insufficient to go round, the legumes are pressed into service directly as providers of food, feed, oil, fibre, etc., and also indirectly as a source of additional nitrogen. Many of the legumes shed their leaves as they ripen, thus furnishing extra organic matter to the soil. The quantity of such leaf fall is considerable in crops like *avare* and *togari* which have a prolonged season of growth. Early and late crops are so mixed, as to keep the land under cover as long as practicable. This proves the benefit of keeping down weed growth, in mitigating the evils of erosion and of value in conservation. That nitrification in the soil proceeds more satisfactorily under cover than when the soil is exposed, is well known. Since the harvest is spread over, the pressure on labour on the farm escapes undue stresses. Differences of maturity are suitably blended with variations in habit, thus avoiding unhealthy competition for the available air and light. Early crops with a rapid rate of growth are associated with late ones which are usually slow to start. When crops come to maturity at about the same time, their habit differences are made use of to advantage. If crops are of similar habit, the evil is mitigated by utilizing differences in the period taken to ripen. Such crops as have a trailing habit act as a partial cover and to some extent reduce the damage caused by erosion. Erect growing crops associated with twiners and trailers, provide a support to their weak stemmed neighbours. The growth period of most crops is so adjusted, as to make a complete use of the rainfall; the bulk of which falls during warm weather, when most crops will be actively growing.

The root habit of crops in a mixture also exhibit a similar advantage in combination; making the utmost use of available moisture and nutrients in the soil, without leading to undue exhaustion. Deep and shallow-rooted crops are usually mixed to advantage, as well as plants with fibrous roots and those with a well-developed tap root and laterals. If early crops are

shallow rooted, they are usually drought resistant. Many long season crops being deep rooted are, to a great extent, naturally fortified against drought. Since the soil is uniformly penetrated and ramified by roots and rootlets, their decay helps in inducing an excellent texture. The deeper penetrating roots help considerably in aerating the soil, and also aid the upward movement of nutrients from the lower layers thus making them available to surface feeders. The great efficacy of *togari* in these respects, is widely realised.

Besides acting as a sort of insurance against the vicissitudes of weather, the mixtures offset or lessen the havoc caused by pests and diseases to a considerable extent. Since pests and causative organisms of disease vary from crop to crop, a conglomeration of crops offers a weaker foothold and acts as a subsequent check to the rapid spread of pests and diseases from the initial points of attack.

In Mysore, much of the mixture is raised in *akkadi* rows consisting of a mixrure of pulses, oil seeds, fibres, etc., *e.g.*, *avare*, niger, sann hemp, castor, *jola*, etc. in *ragi* fields. These rows are usually set at a distance of six to twelve feet in the main crop. The *akkadi* crops are sown in plough furrows after the main crop is broadcast and covered up. Where the major crop is drilled, the *akkadi* is planted through a hollow bamboo tube *sudike*, which usually follows the drill. The *akkadi* may consist of a single crop, or may be made up of several, the seeds of which have been mixed in desired proportion. Where a mixture of seeds is planted at one time, the crop is known as a *mixed crop*. If the crops are not mixed up in the row, but are seeded pure in separate rows, the resulting crop is known as *companionate crop*, *e.g.*, rows of wheat in coriander and Bengalgram fields. *Inter-crops* are short duration crops, set between the rows of long-duration ones, or perennial crops, *e.g.*, *navare* in cotton rows. In plantations such crops help to keep down weeds, form a ground cover, and also result in sure returns to the cultivator, while the major crop takes time to grow up and come into bearing. Even in plantations which are regularly in bearing, these crops provide some return, in off-seasons. Where crops of a mixture are seeded pure in long alternating strips, the practice is termed as *strip cropping*, *e.g.*, black gram and green gram in *jola* fields.

When the produce of a crop in a mixture is required to a limited extent, a small quantity of the seed is broadcast over the entire field, constituting what are known as *sprinklings*. Sometimes, these act as a *guard crop*, as for instance sprinklings of jola in a field of *ragi* or groundnut. The poisonous nature of young jola being widely known over the countryside, the associated ragi or groundnut is usually not troubled by cattle roaming about. Headlands and borders are often put down to a different variety or crop giving rise to what are called *border crops*, *e.g.*, loose headed *jola* around compact headed *jola*. In many instances border crops combine the function of guard crop too, keeping away birds, rodents or cattle, etc., from the

more valuable crops which they surround. In garden lands, these border crops act as live fence, windbreak and shelter. Many trees are found in gardens and plantations which provide shade, and support to twiners and climbers. In places where they are absent, such trees are usually planted, and in many cases consist of species useful by themselves. If they happen to be legumes, their loppings serve both as supplementary feed and as green manure. Short-duration crops seeded for purposes of shelter, are known as *nurse crops, e.g.,* sannhemp in turmaric and ginger.

Patch crops are crops of a different kind, set down in small areas here and there amidst the general crop of the region, *e.g.,* a patch of chillies in *ragi* field. They may represent crops which cannot be raised as sprinklings, due to one reason or another. *Catch crops* are quick growing short season ones, either preceding or following the main crop of the season. When a catch crop follows the main crop, it is often seeded amidst the standing crop which will be nearly ready for harvest. A catch crop is sometimes treated as a *trap crop,* especially in cases where pests are liable to prove troublesome; for example, a crop of *bende* before cotton, or *jola* before cane. The trap crop along with the pests is usually destroyed. Where seasonal conditions are favourable, the land is made to bear two or more crops, one often interpolated in the other. While the first planted crop is nearly mature, it may have in between a second crop vigorously growing up, possibly with another about to be planted or just emerging out of the soil. In this system of *multiple cropping,* each successive crop usually receives an application of manure.

The pattern of agriculture is determined by the nature and amount of rainfall, climate, soil and access to markets. On the basis of natural precipitation the State is divided into two main regions, *Maidan* and *Malnad.* The *Maidan* is a plain or rolling country, with a rainfall rarely in excess of 35 inches during the course of a year. The *Malnad* is more hilly, receiving a precipitation of over 60 inches each year. Between these two is situated a long narrow strip of transition country sometimes styled as Semi-*Malnad.* The climatic zones are *Kar, Hain* and *Hingar.* In *Kar* zone, planting season starts late in April or early in May, the crop season lasting for nearly ten months. The *Hain* zone, has a season of seven to eight months, seeding time being June or July. September or October is the sowing season in the *Hingar* zone, the land being under crops for four to five months thereafter. Soil differences bring out a huge contiguous area of reddish loams, two smaller areas of black soils and a narrow belt of lateritic soils situated in the *Malnad* and as patches in the eastern parts of the State.

Malnad is a region of upland paddy with coffee and tea on hill slopes, areca, pepper and cardamom on the lower slopes and valleys and paddy on bottom lands. *Maidan* bears a variety of crops in a diversified pattern. The *kar* zone is characterised by the prevalence of multiple cropping and

the *hain* zone by mixed strip and companionate crops, and border crops are common in the *hingar* zone.

On red loams, *ragi* is the predominant crop with *avare*, *togari*, castor and niger as *akkadi*. Black soils largely produce *jola* in conjunction with *togari* and cowpeas. Cotton and groundnuts are competing cash crops. The lateritic soils are situated in a zone of very heavy rainfall, excess of rainfall compensating the porous nature of the soil.

The agronomic utility of raising these crop mixtures is further enhanced by certain agricultural operations common to all of them and which result in an appreciable saving of time, labour and investment to the cultivator. A single thoroughly prepared seed bed will raise many crops, eliminating repeated preparation of the land. An easy and facile system of cultivation with simple implements serves to raise several crops which, if grown pure, would require different implements and treatments. The total amount of produce obtained per unit area, is usually in excess over that obtainable if the crops were grown pure. The manual effort called for is high, but agricultural labour is cheap and plentiful and finds no alternative employment. Advance of technology in agriculture should be so geared as to dispense with only that amount of farm labour as can find other gainful employments.

Access to markets influences the variety of crops raised and their nature. Nearby markets cause agriculture to be diversified, an appreciable amount constituting commodities of a perishable nature. Away from markets, crops are fewer with a very low proportion of fruits and vegetables.

Part II

Four major groups can be made out in the crop mixtures prevalent in the State. Of these, two are built up around the staple millets, *ragi* and *jola*, and the other two around cash crops like cotton and various plantation crops.

The Ragi Group.—Approximately, a third of the arable land is under *ragi*, which by far is the most important food crop. It usually occupies red and light coloured soils. Sowings take place both in the *kar* and in the *hain* seasons. Except for about five per cent. of the area, on which an irrigated crop is raised, it is rare to come across a pure stand of *ragi*. Of associated crops, *avare*, *togari* and castor are the more important ones.

Togari and castor are the chief *akkadi* crops in *kar* ragi. Both are deep rooted and take twice as long as *ragi*, or more, to mature. More of castor is found on high lands and in fields with poor or light coloured soils. *Togari* is common on low lands and deep loams. Other subsidiary crops are often found mixed along with *togari* and castor in varying proportions. Of these the more frequent ones are *vogaru-jola*, *same*, *navane*, cowpea, sann hemp, pundi and even mustard. The *akkadi* rows are usually six, eight, or twelve feet apart. On poor soils and in small holdings, the spacing is close. Where holdings are large or the soil fertile, the *akkadi* rows are farther apart.

Approaching Coorg, niger largely replaces *togari* and castor. Little of *avare* is to be seen in *kar ragi*. In parts of Hassan where it is the custom to grow a crop of *guni ragi* (in check rows) every sixth row is put down to *akkadi* crops. Multiple crops of *ragi* and *hurali* are also found in this district; the *hurali* being more frequent in transplanted fields. These fields will not carry any *akkadi* rows. *Hurali* is sown between alternate rows of *ragi*, when the latter is in earheads. In Banavar area, *ragi* and *doddahatti* are grown in companion rows, three rows of *ragi* alternating with one of cotton. Though sown together, *ragi* is gathered much earlier than cotton.

In *hain ragi*, *avare* and *kaki jola* are the chief *akkadi* crops; and these are sown along with other minor crops as in *kar* area. More of mustard is found in *hain ragi* than in *kar*. When sowing rains set in early, castor and *togari* are the predominant *akkadi* crops. *Avare* mostly displaces these, when sowings are in time or slightly late. If sowing showers are received very late, niger is usually put down as the major *akkadi*. On highlands and on poor gravelly lands, castor, *togari* or niger are common in the *akkadi* rows. As fertility improves or the soil increases in depth, these are replaced partially or entirely by *avare*. In many taluks of Kolar and in a few places in Tumkur and Hassan, the rainfall is usually very precarious. In such localities like Bagepalli, Madhugiri and Channarayapatna, the *ragi* crop consists of a mixture of *gidda-ragi* and *dodda-ragi*. If early rains are favourable the close-headed *gidda-ragi* makes a good growth. When early showers fail and late ones are favourable, the straight spiked *dodda-ragi* contributes most to the yield. On the eastern borders of Bangalore and Kolar, a border of *navane* or *jola* often surrounds fields of *ragi*. This, to a certain extent, acts as a guard crop, since young *jola* is poisoncus to livestock and the bristles of *navane* (*mobu-navane*) irritate the snouts of cattle. Near Holalkere, sun-flower is of late mixed with *ragi*.

Patch and strip crops of vegetables like brinjal and chillies are common in *kar* as well as in *hain ragi*. Islands of *baragu* occupy shallow gravelly patches, and paddy is found in low spots which remain moist for a long time. Small patches of spreading groundnut are often seen in *hain ragi*. Melons and cucumbers are found along the bunds or as sprinklings in *kar* fields. In *hain* region, pumpkins, ash-gourds and *budame* are common. *Gouri-yellu*, *same* and *navane* are sometimes mixed with *ragi*. Near Harihar, spanish groundnut used to be intercropped with *ragi*. This practice has dropped out of late, since the arrival of groundnut in the market coincides with that of early cotton and interferes with the ginning of the latter. In many cocoanut gardens of the Tiptur area, the inter-space between the palms is put under *ragi*; likewise *ragi* is also found under tree-mulberries.

The Jola Group.—Jola is grown to an extent of three quarters of a million acres, both as a main crop and as a subsidiary one. The major portion of this is rainfed, the irrigated area fluctuating between 25 to 40 thousand acres.

While raised on all types of soils, the bulk of the crop is situated on black cotton soils in the North and on clayey loams in the South. *Mungar, hain* and *hingar* are three seasons of sowing. The *mungar* crop is raised in parts of Mysore, Mandya and Hassan Districts. Small scattered areas of this crop are also found on the red soils of Chitaldrug, and in Channagiri and Honnali Taluks of Shimoga. The *akkadi* crops are very similar to those found in *ragi*, additional ones being sesamum, *uddu*, and *mara-yellu*. Chillies are often transplanted as row crops in portions of Hunsur and Periyapatna. Navane and *same* are sometimes found as mixtures.

The subsidiary crops in *hain jola* are much the same as in *mungar* sown fields. But on black soils, a greater proportion is made up of *uddu*, *hesaru* and *madki*. In Chitaldrug, Davangere and Harihar taluks, *uddu* and *hesaru* are found as strip crops, twelve rows of *jola* alternating with three of pulses. Lentil is sometimes seen as an *akkadi*. Patches of groundnut and chillies are common. Sprinklings of *jeddu-navane, same, pundi* and *bende* are frequently met with. So also is sun-flower, particularly in Hosadurga and Holalkere. A border of loose-headed *jola*, often surrounds fields sown with compact types. In parts of Chitaldrug, where *hingar* jola is grown, the fields usually have three to six border- and guard-rows of *kusume*. *Kadale*, often along with coriander, is found as a mixture and also in *akkadi* rows. Fodder *jola* is usually raised as a pure crop. Sometimes it may be mixed with *hurali* or cowpea in the proportion of three of *jola* to one of legume. The *hurali* mixture is found in dry fields and cowpea on irrigated land. The *jola* now and then contains sun-flower too, often in addition to the legume already present in the mixture. Like ragi, *jola* is found in cocoanut gardens; but frequent intercrops of this millet are said to ruin the palms.

Other Food Crops.—About three thousand acres of wheat is found in Mysore, partly as a dry crop and partly under irrigation. The dry crop found on black soils in Chitaldrug, has several associate crops. *Kusume* forms guard and border rows. *Kadale* and coriander are mixed with wheat and act as a safeguard, in case of failure of wheat due to attack of rusts. The rust is usually less severe on mixed stands of wheat than on pure ones. *Kadale* sown with wheat is attacked by pod-borers to a lesser extent than when grown by itself. Wheat is sometimes grown as row crop in coriander and *kadale* plots. *Hingar jola* occurs as sprinklings. The irrigated wheat is usually raised pure, except for an occasional sprinkling of *jola*.

The minor millets like *same, sajje, navane* and *haraka* are grown to a limited extent on poor soils. While *haraka* is usually a main crop of the land, *navane* and *same* are generally grown as subordinate. The latter, when grown on poor soils as major crops, are usually situated in areas of low and very uncertain rainfall. *Avare* is the chief *akkadi* in *navane*, others being *kaki jola*, niger, castor and sometimes *togari*. On the black soils of Chitaldrug *sannahatti* is a common companion crop. Niger is the chief

subordinate in fields of *same* and *haraka*; along with a little of *kaki jola pundi* or castor and *jola*. *Sajje* is a main crop of the northern borders of Chitaldrug, Tumkur and Kolar with subsidiary crops as in *navane*.

The paddy crop usually consists of pure stands. In parts of Kadur and Hassan, cowpea, cucurbits and millets are sometimes seen growing on the wider bunds. Under old channels in the Cauvery area, after the dry nurseries are pulled out the surface is thrown up into ridges and planted with chillies. In the channel areas a catch crop is often raised before the paddy is transplanted. This, usually consists of a mixture of a few or more of the following: *hurali, yellu,* sannhemp, *uddu, hesaru,* cowpea and even *jola*. Most of these serve as green manures, and as fodder in case of necessity. In favourable localities a catch crop also follows a crop of paddy. This, usually, consists of either *uddu, hesaru,* cowpea, *kadale* or even niger. These are sometimes seeded in a standing crop of paddy, a little before the harvest is taken up. Under some of the tanks and wells a few short season vegetables are taken after paddy is harvested.

Hurali, the major pulse of the State, occupies an area of nearly eight lakhs of acres. On, over half of this area, the pulse is raised as a main crop. It may be grown pure, or may have *akkadi* rows of niger with a little of *same* or *jola*. The pulse is an important associate of *ragi, jola,* paddy and castor. The convolvulaceous herb *melle* is a common weed of *hurali* fields, and is considered to be valuable forage. *Hurali* is a favourite catch and cover crop and is also used to a considerable extent as a green manure. This legume is frequently met with as a ground cover in cocoanut gardens and orchards, where its soil building virtues are highly appreciated. But, on better grades of *ragi* land, *hurali* is never sown as it is commonly believed to depress the succeeding *ragi* or more possibly it is likely to make a rank growth.

About half a lakh of acres are under *kadale*. The dry crop is found on black soils in Chitaldrug district, in old tank beds in Kadur and Hassan and as a second crop after paddy in channel areas and under tanks. The irrigated crop on red soils is usually grown pure, except for an occasional sprinkling of *jola*. On old tank beds *kadale* has often border rows of *kusume*. *Kusume* is also found as *akkadi* rows. Coriander may form a mixture, or raised pure in strips. A common mixture is three parts of *kadale* to one of coriander. *Menthya* may also form a part of the above. This type of mixture is common in Chitaldrug where seeding is done in plough furrows.

Cash Crops.—Much of the groundnut which covers an area of two and a half lakhs of acres, is grown pure. In parts of Bagepalli, Goribidnur, Madhugiri and Pavgada the spreading types have *akkadi* rows of *togari* or castor with sprinklings of *jola* and *pundi*. In portions of Hassan, the short season bunch type is spaced a foot and a half apart and two rows of *kar ragi* are transplanted later, between the rows of groundnut. Groundnut forms an inter-crop of cocoanut gardens in Tiptur-Arsikere area, of orchards

around Bangalore and of tree mulberry in parts of Kolar. On double cropped lands, the early bunch type is very often the first crop, later followed by cotton, tobacco, wheat, or chillies. In Maddur and Malavalli, this oil seed is very often a first crop of paddy lands.

Due to the depredations of the semi-looper, a considerable portion of the lakh of acres under castor, has always other crops associated with it. But, on poor soils and on elevated situations, particularly in areas of low rainfall, this oil-seed is grown as a major crop. Such stands of castor are frequent in Chiknayakanahally, Hiriyur, Sira, Pavgada and Madhugiri. The rows of castor are usually four to six feet apart. The space between castors has often a companion row of *togari* or an intercrop of *hurali*. Where the land is of better sort, *avare* is found between alternate rows of castor on red loams, and cowpea on dark coloured soils. Sometimes chillies are transplanted between castor when the latter is well up.

Two types of cotton—***mungar*** or ***doddahatti,*** and ***hingar*** or *sannahatti*—are grown over nearly eighty thousand acres. On red soils in Kadur-Banavar area, three rows of *giddaragi* or early bunch groundnut, form a companion crop to a single row of *doddahatti.* In parts of Holalkere, Hosadurga, Sira and Madhugiri, five to seven rows of *navane* alternate with one of *sannahatti.* Locally, the cotton is known as *navane hatti.* The cotton may also carry sprinklings of *hingar jola,* groundnut and *bende.*

About half a lakh of acres are under sugarcane. It is usually grown pure and under irrigation. In parts of Chikkballapur and T. Narsipur, radish, onion, greens and sannhemp are grown between the rows of young cane. The western and southern borders of cane fields, often have a border row of castor or garden *togari.* At other places, the fields have a border row of *sesbanias* or *huccha kabbu* which serve as guard row and wind-break.

Plantation Crops.—Of three chief plantation crops cocoanuts, coffee and areca, the first is raised to an extent of a lakh and three quarters of acres. The plantations are mostly found along valleys in the maidan. While this is the major crop in most plantations, in a few gardens this palm is treated as a subsidiary growth. Many cocoanuts are also found around dwellings in towns and in villages. In a well-managed garden the stand consists of palms of several ages, old trees being continually replaced by younger ones. When a plantation commands facilities of irrigation, a nurse crop of plantains is put in, some five to six months before the palm seedlings are planted. After the palm seedlings become established, the plantain which started as a nurse crop becomes an inter-crop. The plantain stays on the land for about three years, after which period the clumps are pulled out. Sometimes the crop remains on the land as long as six to seven years, but this prolonged stay is supposed to exhaust the soil and retard the growth of young palms. Where the gardens are in the open, the individual young palms are usually protected by a hedge of thorns or *kalli.* The belief is common that both the plantains

and the *kalli* hedge considerably keep down the population of beetles attacking cocoanuts.

In young gardens, the space between the palms is often intercropped with *ragi* or *jola* in association with pulses like *avare* or cowpea. Groundnut, *uddu, hesaru* and cucurbits are also frequently raised. Where water is available, the intercrops are more often chillies, onion or garlic. Around Channapatna, betel vines and sugarcane are frequently seen in cocoanut gardens. Progressive owners of gardens raise a cover crop of legumes like *hurali*, cowpea or sannhemp and plough it in, later. Areca, jack, mango, and oranges are sometimes found in association with cocoanut. Such mixed gardens are frequent in Mysore District and in the taluks of Gubbi, Kunigal, Maddur and Channapatna, etc.

Coffee which is found on a lakh of acres is essentially a crop of malnad hill slopes and is invariably grown under shade. While clearing the forest prior to planting, suitable shade trees like species of *Ficus, Terminalia, Bischoffia, Artocarpus* and *Albizzia* are retained. When paucity of natural shade is felt, other trees are planted to provide shade for coffee. Short-lived shade is furnished by plants like the Indian Coral, white Popinac and Madre-de-Cacao. Shade trees of a longer duration are Silver Oak, *Albizzias, Dalbergias, Syzygiums* and *Acacias.* A few plantations employ cover crops like *Boga medaloa,* crotalarias, and the butterfly peas. Many plantations have a supplementary crop of pepper on the higher slopes and cardamom in the valleys. Oranges, vanilla, cinchona, nutmeg, tung oil and yams are to be met with in a few estates.

Of nearly forty thousand acres under areca, the greater portion is found in the *malnad. Maidan* gardens unlike those situated in *malnad,* are usually under irrigation. An areca garden invariably consists of trees of varying ages. Interplanting of young areca amidst older palms is more systematically carried out than in the case of cocoanuts. For one thing, the areca has a much shorter life than cocoanut and frequent replantings are necessary to maintain consistent yields. The most common associate of areca is plantain. The plantains in a garden may consist of two or three varieties or may be mixture of many, the more common ones being *budubale, vatebale, rasabale* and *karibale.* The borders are planted with *Erythrinas, Sesbanias* and Jack, which also serve as wind-breaks. Trees like mango, jack, orange, lime, guava and cocoanuts associated with areca, provide shade and form an additional source of income. Like the plantain, the betelvine is another constant associate of areca, in the malnads as well as in the maidan. The gardens near Sagar, Nagar and Thirthahalli have pepper on the higher slopes and cardamom lower down. Some of these gardens also carry yams and pineapples. The areca gardens at Sringeri and Koppa have less of cardamom and pepper than gardens situated near Thirthahalli. Near Shimoga and Tarikere, betelvines are particularly abundant. Near Tarikere the gardens

have cocoanuts along their borders, which palm is absent in typical gardens of *malnad*. A few chillies of the vine type are also found in this locality. Vine chillies are again to be seen in Goribidnur area. With the exception of cardamom and pepper, the other associates of areca in *malnad* gardens are also present in the *maidan*.

Fruit Crops.—About twenty-five thousand acres of mangoes are found in maidan parts of the State. A garden is usually planted with a number of varieties like *badami, malagoba, raspuri, thothapuri* and *neelam*. Young gardens commonly have an inter-crop of millets or *hurali*. Nearly four thousand acres of orange, either pure or in association with coffee, are found in portions of Hassan and Kadur. The pure groves near Saklaspur and Yemmedoddi, have a few limes interplanted. Apple gardens have a hedge of sesbanias. Sannhemp and tephrosias are used as cover crops and green manures. *Hurali* and groundnut are common intercrops. *Nati-ragi* is sometimes transplanted between the apple plants and pineapples along the channels. Other fruit plants usually grown as an admixture are guavas, pomegranates, lime, pamelo, papaya and figs. Many orchards also bear a supplementary crop of vegetables.

Plantains are raised on about twenty thousand acres. Gardens of this as the major crop are to be found throughout the *maidan*, where facilities for irrigation exist. Each garden has a mixture of varieties, the more common ones being *puttabale, yalakkibale, rasabale, madhurangabale, chainabale, karibale* and *pachabale*. *Maraharalu* and *totada togari* are common around the borders. Hedges and wind-breaks usually consist of *erythrinas* and *sesbanias*. Where heavy winds are frequent, *huchukabbu* is used for hedges. A few garden owners are recently trying pineapple as an inter-crop.

Vegetable Crops.—The culture of vegetables affords innumerable instances and varied types of mixtures. In passing, mention may be made of the practice of raising a mixture of greens in beds of onions and along the channels. Onion beds frequently bear a marginal row of garlic and garlic one of onions. Carrot, *menthya*, radish, coriander, knol-khol and *bende* are often found in one and the same bed. A third type has cabbage at the corners of beds, cauliflower in the middle and a mixture of knol-khol and radish in between.

In concluding, it is worth while to find out the possibilities of introducing the following mixtures into the varied modes of raising crops, that already exist in the State. In parts of Tumkur and Kolar, where groundnut is an important cash crop, the drill-sown *hain ragi* may conveniently have companion rows of groundnut like H.G. I. One row of groundnut may follow five of *ragi*. Long duration types of *uddu* and *hesaru* may also be sown along with *hain ragi*, either as companion rows or in alternating strips. The local production of both these pulses, is far short of the demands of the market. In Belur and Chickmagalur, the paddy crop broadcast in *Karthika*

may carry a certain amount of ***kadale*** as a mixture. The possibilities of raising soya beans on bunds of paddy fields are to be looked into. ***Baje*** and *kesave* may be profitably grown on the borders of paddy. Where paddy fields are double cropped, the ***udu*** type of cultivation may be tried. Swamps adjoining cultivated lands can be cleared gradually and planted with matting rushes. The crop of rushes will prove complimentary to the main crop of paddy. Velvet beans can be included in the mixture of green manures grown on paddy fields as a catch crop. The beans may also be raised along with fodder *jola* and between rows of castor.

In paddy fields under lift irrigation an inter-crop of ***nati-ragi*** and a spreading groundnut may be taken before a crop of paddy. Or, the ***ragi*** may be transplanted first and groundnut dibbled in between rows of ***ragi*** when the latter is in earheads. In lands under Irwin Canal, long-staple American cotton can be planted on the margins of ***ragi*** beds. In this area, trials may also be conducted to raise a suitable crop of green manure between rows of cotton and sugarcane. Cane may carry a greater amount of onion and bende as inter-crops, and Khus khus, patchouli or mango-ginger as border crops. When a severe lack of food grain is felt the *adsal* planted cane may have an inter crop of paddy or ***nati-ragi.*** If pineapples can be established in this region, patchouli may be planted between alternate rows of pines. Missing hills of potato can be planted with dwarf French beans.

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Glossary

Adsal, July–August, season for planting sugarcane.
Avare, *Dolichos lablab.*
Baje, *Acorus calamus.*
Bale, Plantain.
Baragu, *Panicum miliaceum.*
Bende, *Hibiscus esculentus.*
Betelvine, Piper betle.
Boga medola, *Tephrosia candida.*
Brinjal, *Solanum melongena.*
Budame, *Cucumis trigonus.*
Doddahatti, American cotton.
Ellu, *Sesamum orientale.*
Garden Togari, A perennial bush type of *Cajanus cajan.*
Gouri-Ellu, *Sesamum orientale.*
Greens, Herbs of Amarantaceæ, Chenopodiaceæ and Portulacaceæ.
Haraka, *Paspalum scrobiculatum.*
Hesaru, *Phaseolus aureus*—green gram.
Huccha kabbu, *Saccharum* sp.
Hurali, *Dolichos biflorous.*
Jeddu Navane, A variety of *Setaria italica.*
Jola, *Sorghum vulgare.*
Kadale, *Cicer arietinum.*
Kaki Jola, A variety of sorghum used as a fodder.
Kalli, *Euphorbia tirucalli.*

Karthika, October–November.
Kesave, *Colocasia esculenta.*
Kusume, *Carthamus tinctortus.*
Madki, *Phaseolus aconitifolius.*
Mango Ginger, *Curcuma amada.*
Melle, *Ipomœa hispida.*
Menthya, *Trigonella fœnum grœcum.*
Mobu Navane, A variety of *Setaria italica.*
Mara yellu, A variety of niger.
Nati-Ragi, *Eleusine coracana*, transplanted and irrigated.
Navane, *Setaria italica.*
Pundi, *Hibiscus cannabinus.*
Ragi, *Eleusine coracana.*
Sajje, *Pennisetem typhoides.*
Same, *Panicum miliare.*
Sannahatti, Indian Cotton.
Togari, *Cajanus cajan.*
Uddu, *Phaseolus mungo*–black gram.
Vogaru Jola, A variety of *Sorghum vulgare.*

The Field-Day and the Assembly, 25th November 1945

The Annual Field-Day of the Mysore Agricultural and Experimental Union was held at the Irwin Canal Farm on 25th November 1945. Lorries of the Agricultural Department were in service to convey the members and visitors from Mandya town to the Farm in the morning and back in the evening. Members arrived in considerable numbers and the morning was occupied in going round the fields. Several Farm machines including the 6 H.P. Holder Tractor were on view and the demonstrations were much appreciated. The meeting commenced after meals and nearly a thousand audience were gathered at the Field-Day Assembly which commenced at 3–30 p.m., under the Chairmanship of the Minister for Agriculture.

Messages wishing the function success were received from Dr. T. C. M. Royan, Minister for Education and Public Health, Prof. V. K. Badami, L.Ag., Ph.D., University Professor of Agriculture, Benares Hindu University, Major C. B. Oakley, V.D., A.M.I.M.E, M.I.M. and M.E., and other well-wishers.

The President of the Union welcomed the members and invitees, tracing the development of the Union, and explaining the purpose of the organisation and the Regional Committees and affiliated associations.

Girl Prema sang a *lavani* consisting of much agricultural wisdom and thus began the assembly.

The Vice-President, Mr. S. Srinivas, spoke about the work of the Union, touching upon the resolutions made in the previous year and requirements of the Union.

The papers scheduled were presented in the following order*:—

1. "Purpose and Prospects of Propaganda in connection with Grow More Food Campaign", by Mr. M. Narayana Reddi, B.Sc., Officer in Charge, 'Grow More Food' Campaign.
2. "Mechanical Aids to Agriculture", by Mr. K. H. Srinivasan, M.A., B.Sc. (Ed.), Deputy Director of Agriculture.
3. "Soil Conservation and Improvement in Relation to Crop Production," by Dr. B. T. Narayanan, B.A., Ph.D., Agricultural Chemist.
4. "Vegetable Cultivation", by Mr. K. Nanjappa, F.R.H.S., Officer in Charge, Vegetable Production.

The Chairman delivered his speech the text of which is being published elsewhere in the Journal.

Representatives from different regional committees and affiliated associations were introduced to the Minister.

The function closed with the National Anthem and three cheers to His Highness the Maharaja of Mysore.

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* These popular talks have already been published in the Kannada issue of the Journal.

The Speech of Mr. S. Srinivas, F.R.H.S., Vice-President, The Mysore Agricultural and Experimental Union at the 26th Field-Day Assembly, held on the Irwin Canal Farm, on Sunday, the 25th November 1945, at 3-30 p.m.

PRESIDENT AND GENTLEMEN,

It is my pleasant duty to begin by stating that our transactions during the year under report have doubled and in the course of the expansion of our activities we have already formed one District Committee, 9 Taluk Committees and 38 affiliated associations.

Against these figures, however, it is to be observed that there are 9 districts, 80 taluks and 363 hoblies and many more villages to be covered. The matter is receiving attention and this field is expected to be covered shortly under the guidance of our Director and Deputy Director of Agriculture and the devoted co-operation of the Assistant Directors of Agriculture in the districts.

Our members number more than 1,400 and we expect to welcome many more into our fold. A few are slowly coming forward to be our life-members. Last year there were two of them. We have now four. I put it to more of my friends to see that the number is increased so as to give the Union a stability.

It was very sad to learn of the demise of one of our members in the Tarikere Taluk, Mr. Mugali Siddaramanna, who was one of our life-members, just as we were forming the Tarikere Taluk Committee. He who is dead, honour him with remembrance !

Reading through the recent issues of our Journal, I see that small notes contributed by practical agriculturists are really encouraging. 'Vire Chillies at Tarikere', 'Trial of Potatoes in Sagar', 'Seed Rate for Paddy', 'The Care Bestowed by the Owners Makes Subvention Farms Successful', and such other topics are indicative that our members do scientifically think of their occupation wherever definite projects are placed before them. ! And that is exactly the idea of the Agricultural and Experimental Union.

One other aspect has forced itself on our attention the more we have tried to expand ourselves into a bigger body through the Regional Committees; that is the necessity of building up our agricultural service on a much larger scale than at present, large as it has already grown up during the last few years. It is of course essential that the people themselves should co-operate with the Department of Agriculture to a greater extent in this regard.

May I now refer to our resolutions of the previous meeting and points arising out of them.

Subvention.—It was resolved in the last Annual General Body Meeting that in view of the expansion of the Union, Government should be requested to kindly grant an enhanced subvention to the Union, and we are expecting favourable orders of the Government in the matter.

Union Home.—Similarly the request for a site and building for the Union consisting of its home and an agricultural museum and library is pending before the Government and the spaciousness of the building in which we are going to be housed depends both on the generosity of the Government and the extent to which our members themselves make up their minds to contribute towards the building fund.

The Deputy Director of Agriculture, Mr. K. H. Srinivasan, explained the Grow More Food Campaign to our members in the last Annual Meeting and it was resolved "that to effectively carry out the above idea, the members should try their best to form a Grow More Food Committee for each Hobli". Behind the

resolution is the spirit of forming the hobli committees that are already on our programme and I may suggest to my friends that these committees may be helpful in several ways holding mutual consultations with the Department of Agriculture, arranging field-days, competitions, shows and experiments in their jurisdiction, and arranging the agricultural service in co-operation with the Department in their localities to their requirement.

Representation.—In response to the request for representation to the Union on different bodies, a seat has been given to the Union in the Policy Committee on Agriculture in the Economic Conference. Our gratitude is due to the representation accorded. The request for seats in the Representative Assembly and the Legislative Council is, however, before the Government.

The Agricultural College.—The following proposition about higher agricultural education was also moved in our last meeting stating "that this body feels that in the interest of agricultural science in this province, a Degree Course should be provided for the subject in the University of Mysore and that while wholeheartedly supporting the move already made in the direction, the body recommends that action must be considerably expedited and would be very glad to see an Agricultural College started next June". Before now we had expected to see a college arising. May we hope that something will be done the next immediate academic season?

While the membership of our Union is increasing it is rather discouraging that the number of Village Panchayats and Middle Schools subscribing to the Journal are decreasing.

Regarding the schools, even apart from actual subscription to our Journal, there ought to be a more intensive co-ordination by way of agricultural clubs. This need not frighten us as a big idea. Most of the middle schools are situated in rural surroundings. Cannot the boys be given certain projects which will train their powers of observation and give them an appreciation of agricultural facts and figures? We have a programme of this kind included in Scout Training and similar movements and when the Agricultural and Experimental Union suggests it, the only difference, if it is that, is a slightly greater stress on agriculture. In certain issues of our Journal I see articles contributed by the teachers of Agricultural Middle Schools, and also series of agricultural lessons. It is in the same line of thought that one should feel happy at the prospect of an youngsters' club in a middle school formed round the nucleus of the Union Journal. From the clubs of school boys to the organisation of the grown-ups would be a scientific sequence.

Speaking of the elders I cannot but quote from the speech made by our President, the Director of Agriculture, Mr. M. J. Narasimhan, at the Silver Jubilee last year—"In course of time the Union should extend its co-operation to the extension work of the Department. There will be greater chances of success in carrying out an organised programme, for their influence in the villages is bound to be greater than the best efforts of the Departmental staff." In fact, it is the idea that the Union men should be able to help their several localities in crop planning, co-operative farming and all the projects that touch upon and improve their basic industry.

The Model Farm.—I wish to point out here in continuation of the mention made about it in the Silver Jubilee Number of our Journal, that this falls in line with many post-war suggestions. A model farm in each Hobli established with the suggestion and co-operation of the local committee of the Agricultural and Experimental Union would be a model farm and a service station in one, with its fields and orchard, seed and machine stores, cattle and poultry yards and other possible sections. It would be what all the other farms considered under separate schemes put together would be, with the advantage of the required co-ordination of various branches so essential to the success of local agriculture.

Alongside the model farm might be mentioned the *model village forests*, pointed out by the Director of Agriculture from a recent American Bulletin, as worthy of adoption. The general principle is like that of our own village groves raised round local temples but modern ideas are introduced by suggesting systematic planting of timber and other economic plants, making the plantation a place of botanical study for rural school students, laying out pathways, ponds, and resting-places for recreation of the rural folk, and introducing human interest into the effort in various ways.

Some of our friends have been suggesting that the Union should be represented at the Dasara and other exhibitions. This is as much to say that Union members should make it a point to send specimens of their produce to be exhibited. We have the assurance from the Director of Agriculture that there has been the idea all along of exhibiting the different kinds of produce sent by the clients of the Department and the idea should be very welcome if the members of the Union do offer some exhibits which may be systematically collected through the district officers of the Department for display at the different exhibitions.

For the last two years we tried to place some of our journals at the Dasara Exhibition and by the way interested persons made enquiries, one point seems to deserve attention. There was a demand for small books on different crops and particular agricultural subjects like manure, silage, etc. While asking for books on crops there was a demand for books treating about each crop in entirety from cultivation to harvest and processing, as against pamphlets dealing with isolated aspects like mere varieties or diseases. Whether done departmentally or under the name of the Union publication of such books seems to be a necessity. They would add to the value of the exhibition of which agricultural literature is to form a part and would make good additions to the village libraries.

The Propaganda Van is one which the Union would like to identify itself with. A motor van with a cinema projector and a few films on agricultural topics may be arranged at a cost of ten to fifteen thousand rupees. It would help to attract rural people and when a local organisation like the regional committees of the Union is enabled to include this in a programme of its meetings, it can make this entertainment the starting point of educating the farmers further to think more leisurely and adopt the improvements indicated in addition to knowing about them. Happily the Government have also been alive to the importance of this line of propaganda. Considering the subject that a propaganda section in the Agricultural Department has to be opened, that for this a special officer with cinema equipment rigged up in a van would be very helpful to carry on propaganda to remote corners of the State, that the benefit of this would be incalculable and that it would cost about Rs. 15,000 for equipment and Rs. 8,000 for recurring expenditure, a resolution has been made in the Officers' meeting held in the Chambers of the Minister for Public Works on 25th September 1945, that this is a very legitimate request of the Department and that the Director of Agriculture may send up suitable proposals to Government in the matter.

Study Tours.—Two kinds of these have been discussed off and on. One is sending selected Union members throughout India to see outside farms and schemes and help us with their acquired knowledge when they return. The second is selection of villagers and sending them to different Government farms in the State for short courses of study. One farmer from each hobli may be selected each year in turn and the local regional committees may be consulted in the matter.

I have put together some of these ideas in a thankful attitude towards those who have credited us as being a liaison between the research workers and practical agriculturists. In this regard I may quote the words of "*The Hindu*" of 14th October reviewing our Silver Jubilee Number :—"The Mysore Agricultural and Experimental Union serves as a useful liaison between the Government

Agricultural Department and the ryot to canalise the fruits of research carried on under Government and its own auspices. The record of achievement of the Union during the past 25 years found detailed in the Journal is impressive and shows the extent to which agriculture could be benefited by such non-official agencies. Production in the State meets the people's requirements only half-way and the efforts of the Union deserve adequate support from the State and ready response to suggestions from the ryots as solicited in the articles in the Special Number."

As I think that it is the cardinal principle of co-ordination that will enable us to live up to this credit, I cannot help mentioning about two subjects which we are likely to miss in our deliberations. One is the subject of agricultural economics and farm cost studies which as Dr. Coleman has suggested can be studied better on our members' own farms than on experimental stations. We are doing a mistake by not heeding to the advice. Some such studies ought to be discussed in our meetings and contributed to our Journals by our members. The second is the subject of our cattle. Our own beautiful cattle await selection for milk qualities. They form an intergal part of agriculture. Analytical study is good but we have to synthesise the crop on the one side and the animal on the other into one business of agriculture. Looking back to previous numbers of our Journals it is seen that quite a number of pages used to be read and discussion held about cattle problems on our platform. Some of our field-days have been made venues for cattle shows as well. I believe we stand to gain by remembering the old example.

An Agricultural Bank.—One of our members who is a good agriculturist has sent up for consideration an important subject, that of establishing an Agricultural Bank which can finance the interested agriculturists to improve their farming. There are already various arrangements for this but it requires deliberation as to why certain agriculturists feel they are not properly financed. To me it seems that a co-operative organisation to which the farmer can entrust his product for marketing and which in turn can both finance him to some extent and largely help him with seeds, manures and other stocks and services, if possible, may be tried with advantage. This, I believe, should also solve the important problem of fixation of prices of agricultural commodities, so that the bad effects of depression should not be repeated.

On behalf of all our members I express our gratitude to the Minister for Agriculture for having consented to preside over this function in the midst of his multifarious duties.

Proceedings of the 26th Annual Meeting of the Mysore Agricultural and Experimental Union

The meeting was held on the Irwin Canal Farm, Mandya, on the afternoon of Sunday, the 25th November 1945. More than two hundred members were present.

The members were informed of the demise of Mr. Sabbanhalli Lakshman Reddi, for long a member of our Union. A condolence resolution was passed by the assembly.

The Secretary presented his report for 1944–45, which was passed along with the Budget Estimate for 1945–46.

Secretary's Report

"First let me present the audited Statement of Accounts for 1944–45. It will be seen from the Income and Expenditure account that the volume of business as compared with that of last year has actually doubled.

Statement of Income and Expenditure for 1944–45

Expenditure	Rs.	A.	P.	Income	Rs.	A.	P.
To Establishment Charges ..	2,524	1	0	By Admission Fee ..	862	0	0
,, Printing ..	3,216	12	0	,, Membership Fee ..	3,911	0	0
,, Postage ..	329	12	9	,, Subscription ..	278	0	0
,, Stationery ..	34	14	9	,, Advertisement Charges ..	240	0	0
,, Contingency ..	68	4	0	,, Subvention ..	2 000	0	0
,, Audit Fee ..	25	0	0	,, Miscellaneous ..	150	14	0
,, Silver Jubilee Function ..	1,351	15	3	,, Field-Day and Silvr Jubilee Donations ..	654	11	9
,, Depreciation ..	9	9	10				
,, Time-piece (written off) ..	6	0	0				
,, Excess of Income over Expenditure ..	530	4	2				
Total ..	8,096	9	9	Total ..	8,096	9	9

Balance Sheet as on 30th June 1945

Liabilities			Rs.	A.	P.	Assets			Rs.	A.	P.
Fund ..			1 253	10	9	Cash on Hand ..			22	3	0
Life-Membership Fee ..			325	0	0	Cash in Government Savings Bank ..			861	13	2
Bangalore Press ..			1,440	12	0	Postage Stamps on Hand ..			2	15	3
Subscriptions received in advance from—						Furniture ..			178	0	0
Members	Rs. 406	10	0			Library ..			270	15	0
Subscribers	79	11	0			Arrears due from—					
			486	5	0	Members	Rs. 2,474	12	0		
Excess of Income over Expense	Rs. 530	4	2			Subscribers	114	2	0		
Less Excess of Expenditure over income to end of 1943–44	63	11	6						2.588	14	0
						Advertisement Charges ..			47	8	0
			466	8	8						
Total ..			3,972	4	5	Total ..			3,972	4	5

Counting from our mailing lists the number of our present members and subscribers is seen to be as follows :—

Members :

English Journal—	
Official	153
Non-official	104
Kannada Journal	1,188
Subscribers :	
English Journal	50
Kannada Journal—	
Middle Schools	30
Village Panchayats	16
Individuals	13
Total	1,554

This represents an increase of nearly 300 over the number as it stood at the last meeting.

We have four life-members now as against two of last year.

Affiliated Associations.—The number of these increased from 12 to 38. We have now 34 such associations in the Shimoga District, 2 in the Bangalore District, and 1 each in Tumkur and Hassan Districts.

District and Taluk Committees.—Taluk Committees have been formed in all the taluks of the Kadur District with a District Committee at Chikmagalur. There is one Taluk Committee in Bangalore and one in the Mysore District. Thus there are 9 taluk committees and one district committee and others are being formed.

Journals.—Special Silver Jubilee Numbers both in English and Kannada have been published. Owing to circumstances there has been a certain delay in bringing out the English Journal but it is being made up.

Arrears of Subscription.—The Auditor's remarks in this regard sums up the situation :—

> "In spite of special efforts made, it is observed that the collections towards arrears continue to be unsatisfactory. Under Clause 8 of the 'Constitution and Rules', members who are in arrears of their subscription for two years consecutively shall cease to be members. This has yet to be enforced."

Some arrears have had to be written off where letters of resignation were received and it was definitely known that amounts could not be collected. In general, attempts are being made to see to the collections as far as possible.

Other Points.—Government were approached regarding representation to the Union on different constitutional bodies. A seat has been given on the Agricultural Policy Committee of the Economic Conference.

Regarding the Union Home, Government have been requested in the matter and the question is in the stage of correspondence.

Estimated expenditure for 1945-46, approved by the Committee of Management, stands as follows :—

	Rs.
Establishment	2,990
Printing of English Journals—	
2 pending numbers	400
4 current numbers	800
Kannada Journal—	
11 usual numbers	1,320
1 special number	800
Postage	400
Field-Day	500
Expenses in connection with regional committees	1,000
TOTAL	8,210

Owing to high rates of printing the excess of expenditure pertaining to last year was ratified in the last Managing Committee meeting. Similarly, certain expenses are likely to go higher this year also. For example, the Kannada Special Number estimated at Rs. 800 has cost about Rs. 900. With the possible margin for these extra costs the General Budget is presented for adoption.'

The Committee was constituted for the next one year standing as follows after the formation :—

President.—Mr. M. J. Narasimhan, B.A., Director of Agriculture in Mysore.

Vice-President.—Mr. S. C. Malliah, M.R.A., Maddur.

Ex-Officio as provided in the constitution.—

The Deputy Director of Agriculture.

The Superintendent of Animal Husbandry and Veterinary Services.

Members.—

Messrs.

V. Venkatappa, Thitmaranahally, Channapatna.
M. P. Subrahmanyaraj Urs, Mysore.
M. L. Linganna, Mandya.
Badri Narayan, Anandapuram, Shimoga District.
Dhruva, M. S., Kolar.
Patel Sivappa, Davangere, Chitaldrug District.
Seshadri Iyengar, Tumkur.
S. Srinivas, F.R.H.S., Bangalore.
B. S. Madhava Rao, Koppa, Kadur District.

Secretary.—Mr. M. Vasudevamurthy, B.Ag.

Mr. S. A. Gangadhara Sastry, M.A., LL.B., M.Com., was appointed Auditor for 1945-46.

The following resolution was moved by Mr. Ardeshahally Seetharamiah and seconded by Commandant R. Hera Singh :—

"That a Sub-Committee be formed from among the members of the Agricultural and Experimental Union to consider formation of an agricultural bank so as to finance the intending agriculturists to capitalise and improve their farming."

It was decided that this subject should be threshed out by the Managing Committee of the Union.

Other subjects were placed before the General Body as follows and they were all passed for being placed before the Director of Agriculture for doing the needful :—

Messrs. Kempegowda of Hemmanahally, H. S. Krishnamurthy of Closepet and M. L. Linganna of Mandya—

Iron materials and other stock should be supplied to the raiyats from the Agricultural Depots without the production of the certificates from Patels and Shanubhogs as at present.

Mr. Chikkahydegowda of Vidyanathapur—

Agreements must not be insisted upon to be executed on stamp paper when selling cart materials from Agricultural Depots.

Wooden parts for carts and mumties should be supplied early.

Mr. C. Parameswarappa, Chennapur, Tarikere Taluk—

The gradual fall in the fertility of dry lands is a matter for investigation.

Bunding should be introduced in black cotton soils as a Government programme.

Sales of seeds, etc., should be entrusted to Food Depots and Village Panchayats.

Tractors should be stationed at Hobli Headquarters for service to raiyats.

Mr. H. S. Krishnamurthy of Hallimala, Closepet Taluk—

Irrigation pumps should be given by the Agricultural Department to raiyats who command water facilities, on instalment system.

Agricultural bulletins must be published on various subjects.

Messrs. M. L. Linganna of Mandya and D. Marilingegowda of Maddur—

Groundnut oil-cake also should be sold at 50% concession in rates just as chemical manures are sold.

The export of groundnut oil-cake from the State should be controlled.

Mr. D. Marilingegowda of Maddur—

Rates of subvention on subvention plots should be increased to Rs. 30 per acre from the present Rs. 10.

Water at present obtaining in the Krishnarajasagar Reservoir should be given to summer ragi and paddy, and further planting of cane this season should be stopped in the Irwin Canal area.

Mr. K. M. Gururaja Rao, L.Ag., Bangalore—

"It is resolved that as *food grain control* will remain under Government for a long time in one way or another and as the propaganda for increased food grain production is not having adequate response, which could be traced, among the causes to the inability of integrated scientific research result being demonstrated successfully on a business scale on Government Farms, this assembly of the Agricultural and Experimental Union strongly recommends to the Government through the Director of Agriculture to convert early as a beginning the two large farms, *viz.*, Irwin Canal Farm and Babbur Farm, to be worked as State Economic Farms with a view to getting reliable cost data of important agricultural crops to facilitate fixing of prices and in agricultural planning."

Mr. Kanale Sivaramiah and delegates from Sagar Taluk—

An Experimental Farm for paddy should be opened in the Sagar Taluk.

An Agricultural School should be opened in the Sagar Taluk.

Manures should be supplied at 50% concession to areca gardens also.

Some working principles should be laid down for village agricultural associations and it should be made clear how the Department proposes to help thes..

The sales of implements should be entrusted to the affiliated association.

Reports of affiliated associations should be published annually.

The Vice-President's speech was presented at the Field-Day assembly.

Mr. Subbaratnam of Bangalore and Mr. Badri Narayan of Anandapurame Shimoga District, promised to be life-members of the Union. The members from the Goribidnur Taluk formed their Regional Committee.

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